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AN ADMINISTRATIVE STUDY OF SAMPLING TECHNIQUES IN DWARF MISTLETOE-INFECTED STANDS

James Walters and Donald Brown

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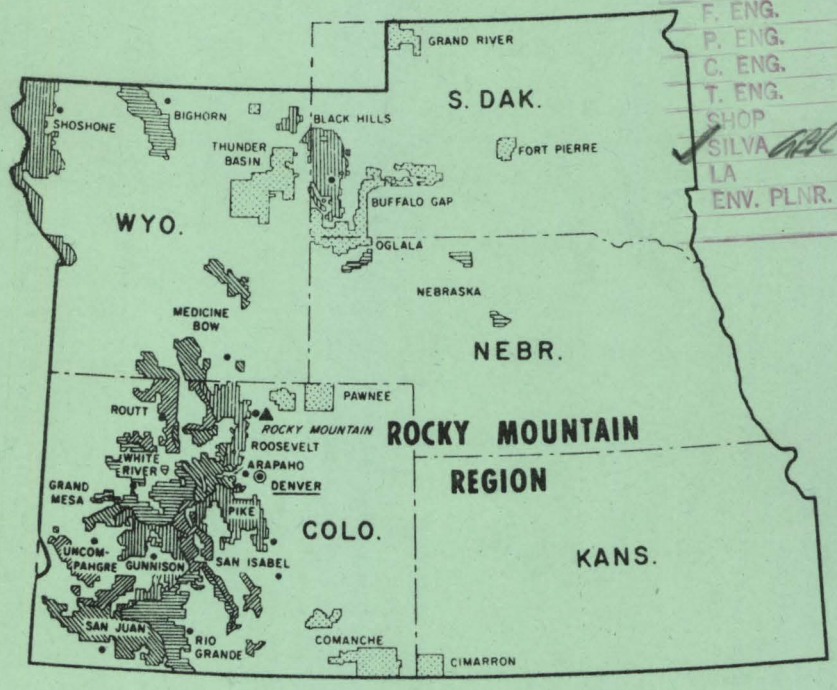

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AN ADMINISTRATIVE STUDY OF SAMPLING TECHNIQUES IN DWARF MISTLETOE-INFECTED STANDS

James Walters and Donald Brown[1]

Introduction

Land managers must make administrative decisions on timber management units containing lodgepole pine (Pinus contorta Dougl.) infected by dwarf mistletoe (Arceuthobium americanum Nutt. ex Engelm.). Since removal of infected trees is the commonly accepted method of suppression, information regarding the intensity, distribution, and impact of dwarf mistletoe will assist the land manager in making an intelligent management decision. A reasonably precise and economical survey procedure is needed to collect this information.

The data collected in the survey can be used in the yield simulation program, LPMIST, to obtain projected yields under various levels of management. An administrative study of survey procedures in 1971 indicated that three survey designs--the third nearest tree (with 2- and 4-chain intervals between sample points), one percent, and Stage II inventory--might meet these requirements. The study was continued in 1972 under more controlled conditions using several replicates for each of the three survey designs.

Objective

Compare the precision of three survey designs in estimating the incidence of dwarf mistletoe and tree density within a management unit.

Methods

The study was to be located in a relatively young stand (20-40 years old) of lodgepole pine with at least 20 percent infection by dwarf mistletoe. A suitable stand of about 10 acres was located in June 1972 in the Foxpark Ranger District, Medicine Bow National Forest, T. 12 N., R. 78 W., Sec. 4 (Map 1). The stand was similar to stands being selected for thinning contracts. The unit was delineated and the boundary marked with paint.

The tree population to be sampled in the surveys was restricted to trees 7 feet and taller (i.e., 1.0 inches or greater d.b.h.) in order to simplify the study. This segment of the total tree population was inventoried in a 100-percent survey during which all infected trees were marked with paint. In this way, any bias on the part of the examiner in detecting infected trees during the other surveys could be almost eliminated. The same tree population was sampled in each survey. A map outlining the stand, made during the 100-percent survey, was used to lay out the various surveys.

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The third nearest tree design was the first one used. Sample points were located at 2- and 4-chain intervals along parallel compass lines 2 and 4 chains apart (Map 2). Whenever possible, sample points were not located within one-half chain of the boundary. The sample point was the center of a variable size plot with a maximum radius of 33 feet in any one direction. Each plot was divided into four quadrants by the intersection of a base line through plot center at right angles to the compass line. The quadrants were examined consecutively in a clockwise direction around plot center. The three living trees nearest to plot center in each quadrant were examined and recorded for the presence or absence of dwarf mistletoe. Only trees within 33 feet of plot center were examined. The distance to the third nearest tree was measured from plot center for use in determining tree density.

A 1-percent fixed plot sample was the next survey design used in the study. Twelve plots, 11.75 feet in radius, provided a 1-percent sample of the stand. The plots were uniformly spaced on transects throughout the stand (Map 3). The trees were examined and recorded for presence or absence of dwarf mistletoe.

The last survey design was the Stage II compartment examination as used for timber resource inventories in Region 2. Only part of the compartment examination procedure was used because, as explained earlier, only part of the total tree population in the stand was used in the study. The survey consisted of 10 plots, 6.8 feet in radius, uniformly spaced over the stand (Map 4). Only sapling size trees (1.0-4.99 inches d.b.h.) were examined and recorded for the presence or absence of dwarf mistletoe.

Each of the three survey designs was replicated four times. Care was taken to prevent any overlapping of sample points between replicates within each survey design.

Results and Discussion

An analysis of the data for each survey design is presented in Tables 1-4. The 2-chain and 4-chain spacings used in the third nearest tree design are shown as separate surveys. One survey had twice the sampling intensity as the other. The data in each table entered under "combination of all replicates" is an estimate of the sampling variation when the data from all the replicates for each survey are pooled and analyzed. The sampling error for the individual replicates, particularly the 2- and 4-chain interval surveys, is more meaningful when comparing survey methods.

Tree density, in combination with the incidence of dwarf mistletoe, is a key factor in the LPMIST simulated yield program. The precision of any survey design in estimating tree density will therefore determine the precision and reliability of the simulated yields.

Analysis of the data collected in this study shows the third nearest tree design using a 2-chain spacing gives the most precise measurement of tree density. The other survey designs, in decreasing order of precision, are

the third nearest tree at 4-chain spacing, the 1-percent survey, and the Stage II inventory survey. There was relatively little sampling variation between any of the surveys in estimating the incidence of dwarf mistletoe.

Tables 1 and 2 contain two estimates of the incidence of dwarf mistletoe infections or percent infection. One was based on all trees examined, or a maximum of 12 trees per plot, and the other was based on the examination of only the third nearest trees, or a maximum of four trees per plot. The estimation of percent infection was about equally precise using either method. An analysis of data collected the same way in the Medicine Bow National Forest by District survey crews shows the same results.

The modified third nearest tree design with observations on only the third nearest trees using a 4-chain spacing will give, on the average, acceptable precision at a reasonable cost. Direct field costs with an experienced 2-man crew should not exceed $1 to $2 per acre.

Table 1.--Two-chain interval survey

	First replicate	Second replicate	Third replicate	Fourth replicate	Combination of all replicates	100% survey
Density (trees/acre)	851	749	788	1,122	804	835
$S_{\bar{x}}$ density (trees/acre)	±12	±12	±16	±26	±7	
Percent $S_{\bar{x}}$ density	±1	±2	±2	±2	±.8	
Percent infection (all trees)	45	45	46	46	45.4	40
$S_{\bar{x}}$ percent infection	±6	±6	±6	±9	±6.8	
$S_{\bar{x}}$ as percent of mean	13	13	13	20	15	
Percent infection (3rd tree only)	41	42	47	45	43.6	

Table 2.--Four-chain interval survey

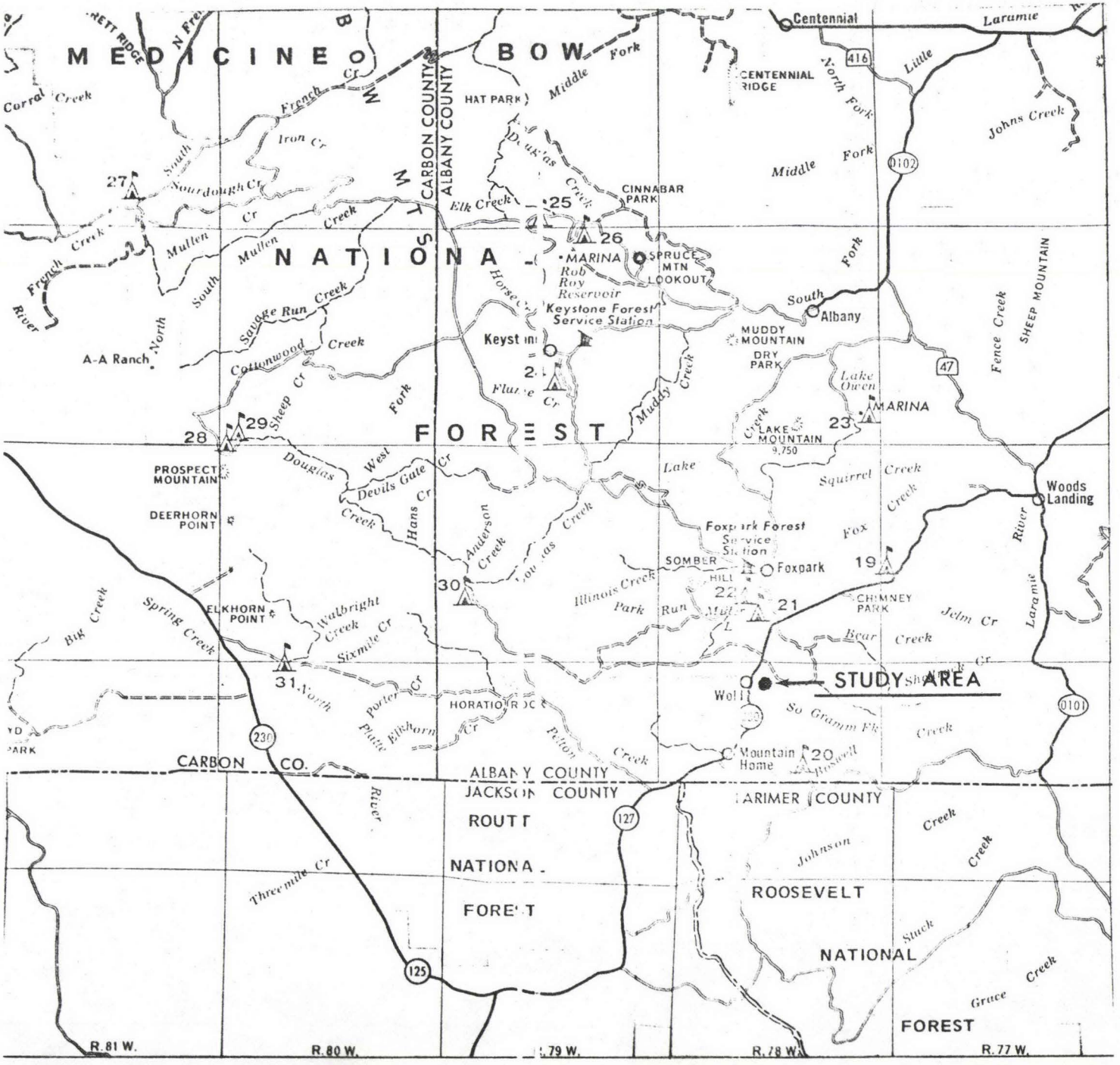
	First replicate	Second replicate	Third replicate	Fourth replicate	Combination of all replicates	100% survey
Density (trees/acre)	1,192	872	1,252	1,354	1,066	835
$S_{\bar{x}}$ density (trees/acre)	±59	±47	±92	±103	±15	
Percent $S_{\bar{x}}$ density	±5	±5	±7	±8	±1.4	
Percent infection (all trees)	50	29	51	40	43	40
$S_{\bar{x}}$ percent infection	±8	±6	±8	±9	±7.7	
$S_{\bar{x}}$ as percent of mean	16	21	16	23	18	
Percent infection (3rd tree only)	45	23	54	42	41.3	

Table 3.--One-percent survey

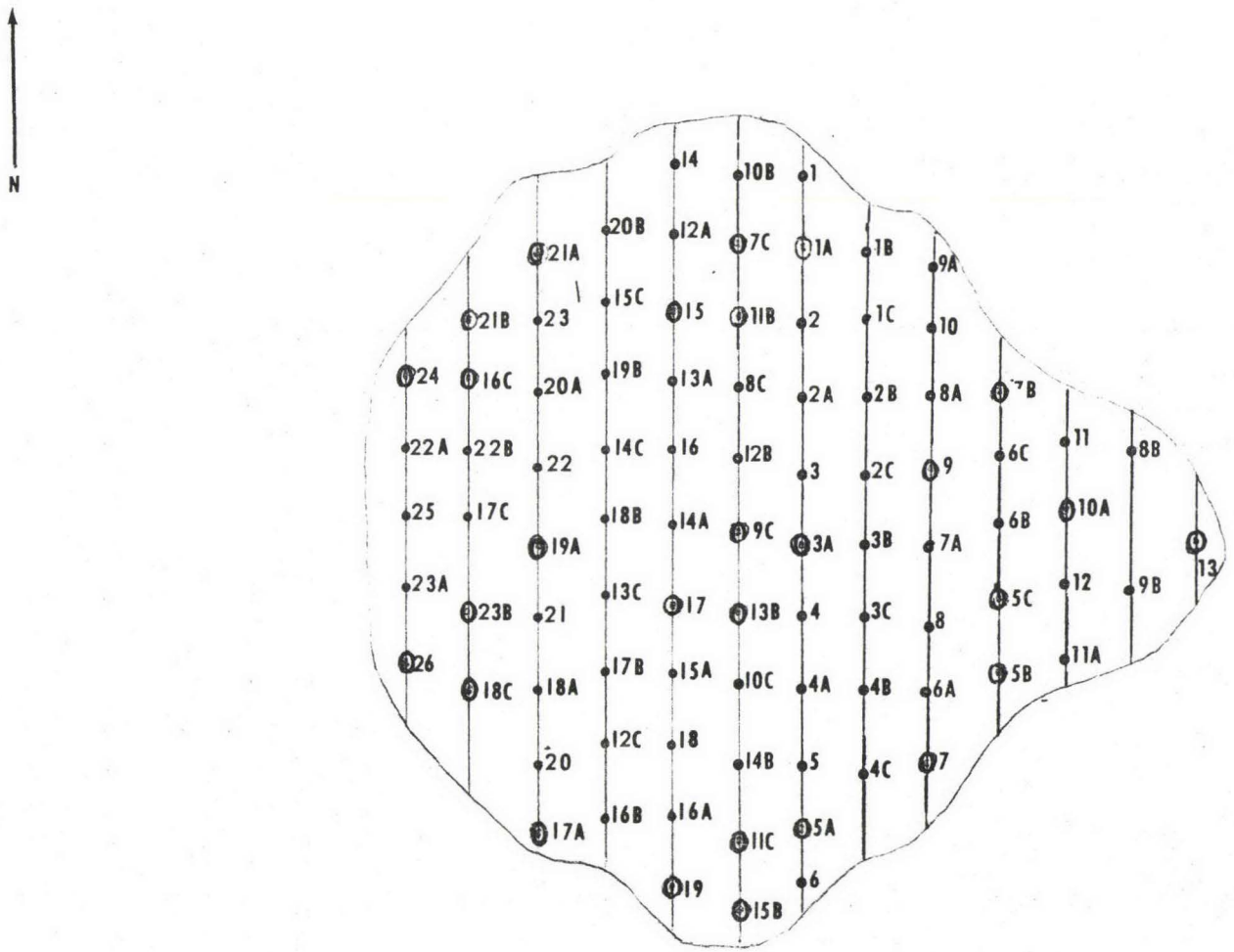
	First replicate	Second replicate	Third replicate	Fourth replicate	Combination of all replicates	100% survey
Density (trees/acre)	778	1,105	994	1,281	1,040	835
$S_{\bar{x}}$ density (trees/acre)	±181	±261	±171	±221	±209	
Percent $S_{\bar{x}}$ density	±23	±24	±17	±17	±20	
Percent infection (all trees)	50	31	34	44	39	40
$S_{\bar{x}}$ percent infection	±4	±4	±4	±3	±3.75	
$S_{\bar{x}}$ as percent of mean	8	13	12	7	10.50	

Table 4.--Stage II inventory survey

	First replicate	Second replicate	Third replicate	Fourth replicate	Combination of all replicates	100% survey
Density (trees/acre)	1,066	1,523	1,493	883	1,240	835
$S_{\bar{x}}$ density (trees/acre)	±853	±853	±426	±213	±586	
Percent $S_{\bar{x}}$ density	±80	±56	±29	±24	±47	
Percent infection (all trees)	63	34	47	52	47	40
$S_{\bar{x}}$ percent infection	±8	±6	±9	±6	±7.25	
$S_{\bar{x}}$ as percent of mean	13	18	19	12	15.50	



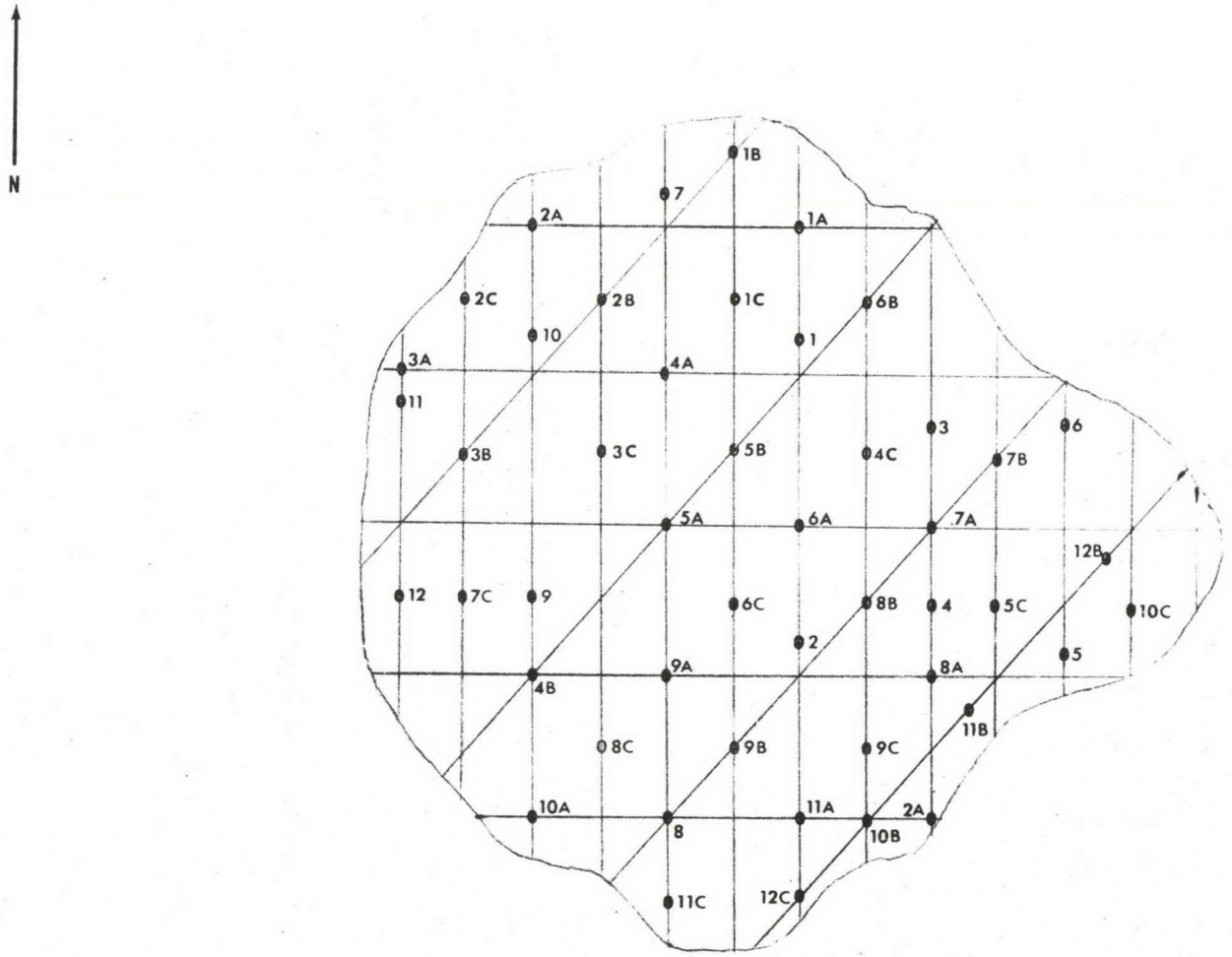
Map 1-- Location of Study Area



Map 2 -- 2- and 4- Chain Dwarf Mistletoe Surveys

o — 2-chain plots
◎ — 4-chain plots
1 — 1st repetition
1A — 2nd repetition
1B — 3rd repetition
1C — 4th repetition

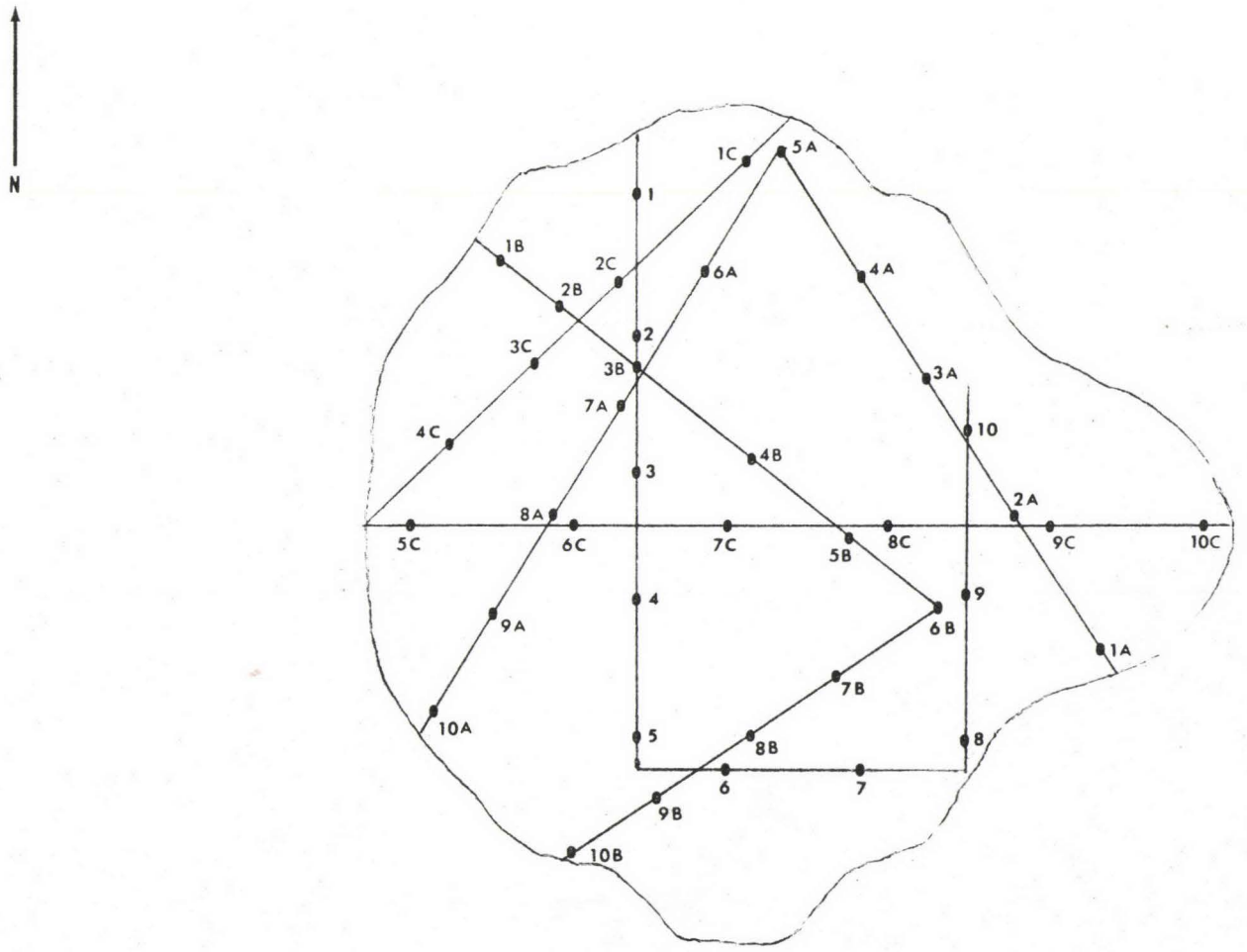
scale : appx. 1cm = 1chain



Map 3 -- One-Percent Dwarf Mistletoe Survey

1 — 1st repetition
1A — 2nd repetition
1B — 3rd repetition
1C — 4th repetition

scale: appx. 1cm=1chain



Map 4 -- Stage II Inventory Survey

1 — 1st repetition
1A — 2nd repetition
1B — 3rd repetition
1C — 4th repetition

scale: appx. 1cm = 1chain